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DESCRIPTION OF THE CRYPTONISCIUM LARVA OF *ENTOPHILUS OMNITECTUS* RICHARDSON, 1903 (CRUSTACEA: ISOPODA: EPICARIDEA) AND RECORDS FROM THE GULF OF MEXICO

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Abstract.—*Entophilus omnitectus* is reported from two new host species, *Munida microphthalma* and *M. valida,* and its range in the Atlantic Ocean is extended from the Azores to the northern Gulf of Mexico. The cryptoniscium larva is described and comments on its maturation to the adult male form are presented. *Entophilus omnitectus* is an internal parasite enclosed by a host sheath that is similar to that surrounding the Entoniscidae. Seven of the eleven host specimens were also parasitized by *Aporobopyrina anomala* Markham, 1973 and/or an unidentified rhizocephalan.

A specimen of *Munida valida* Smith, 1883 collected on a University of West Florida training cruise was parasitized by *Entophilus omnitectus* Richardson, 1903, *Aporobopyrina anomala* Markham, 1973 and an unidentified rhizocephalan. The presence of *E. omnitectus* was indicated by a pore near the anterolateral margin of the host's carapace and by swelling and discoloring of the hepatic region of the carapace. This pore is herein referred to as the "larval exit pore" for its presumed function. Galatheoids from subsequent cruises were examined for external signs of infestation noted above and additional *Entophilus omnitectus* specimens were found.

The material examined has been deposited in the collections of the Smithsonian Institution, Washington, D.C. (USNM) and Marine Research Laboratory, Florida Department of Natural Resources, St. Petersburg (FSBC).

Entophilus omnitectus Richardson, 1903
Figs. 1, 2

Entophilus omnitectus Richardson, 1903: 53–54, figs. 6–8.—Danforth, 1963:17–18, 40 pls. 3, 7; 1970:13, 72–73, fig. 18.—Bourdon 1976:385–391, figs. 20–23; 1979:511.

Material examined.—Gulf of Mexico. Infesting *Munida valida* Smith, 1883. R/V *Bellows* B8403 sta 4; 22 Mar 1984, coll. S. B. Collard, 15 ft flat trawl, 185–370 m, 29°16.53′N, 29°12.06′W to 29°12.06′N, 87°47.97′W, *Aporobopyrina anomala* 1 ♀, 1 ♂ USNM 240129, *Entophilus omnitectus* 1 ♀ (no ♂) USNM 240128, host with rhizocephalan USNM 240127.—R/V *Oregon II* sta 42230; 13 Nov 1984, coll. T. H. Hansknecht, 55 ft shrimp trawl, 640–685 m, 29°09′N, 87°59′W, 2 hosts each with a pair of branchial and internal bopyrids, *Aporobopyrina anomala* 2 ♀, 2 ♂ USNM 240138, *Entophilus omnitectus* 2 ♀, 1 ♂, 1 cryptoniscium larva USNM 240137.—R/V *Gyre* 86-G-2 sta 42; 28 Feb 1986, coll. D. L. Adkison, 30 ft trawl, 620–850 m, 27°47.0′N, 90°16.9′W to 27°46.5′N, 90°12.5′W, *Entophilus omnitectus* 1 ♀ (gravid), 1 ♂, FSBC I-33079, host FSBC I-33080.—R/V *Gyre* 86-G-2 sta 70; 6 Mar 1986, coll. D. L. Adkison, 30 ft trawl, 600–770 m, 27°43.2′N, 91°15.7′W to 27°43.2′N, 91°19.4′W, *Aporobopyrina anomala* 1 ♀ (gravid), 1 ♂ FSBC I-33081, *Entophilus omnitectus* 1 ♀ (no ♂)

FSBC I-33082, host FSBC I-33083.—R/V *Gyre* 86-G-2 sta 76; 7 Mar 1986, coll. D. L. Adkison, 30 ft trawl, 600–750 m, 27°22.1′N, 93°31.1′W to 27°24.9′N, 93°27.8′W, 2 hosts each with a female branchial and internal bopyrid, *Aporobopyrina anomala* 2 ♀ (gravid), 2 ♂ USNM 240132, *Entophilus omnitectus* 2 ♀ (1 gravid), 1 ♂ USNM 240131, host with rhizocephalan USNM 240130.—R/V *Gyre* 87-G-2 sta 26; 5 Mar 1987, coll. D. L. Adkison, 30 ft trawl, 660–1010 m, 27°42.9′N, 91°16.6′W to 27°43.0′N, 91°19.6′W, *Entophilus omnitectus* 1 ♀ (gravid), 1 ♂ USNM 240134, host with rhizocephalan USNM 240133.—M/V *H.O.S. Citation* sample 4502 sta E2A; 13 May 1985, coll. LGL, trawl, 625 m, 28°35.61′N, 86°46.31′W to 28°35.40′N, 86°46.24′W, *Entophilus omnitectus* 1 ♀, 1 ♂ USNM 240126.—M/V *H.O.S. Citation* sample 4508 sta E2D; 16 May 1985, coll. LGL, trawl, 624–631 m, 28°07.44′N, 85°52.31′W to 28°06.78′N, 85°54.09′W, *Entophilus omnitectus* 1 ♀, 1 ♂ USNM 240124.

Infesting *Munida microphthalma* A. Milne Edwards, 1880. R/V *Gyre* 86-G-2, sta 47; 2 Mar 1986, coll. D. L. Adkison, 30 ft trawl, 430–690 m, 28°06.1′N, 89°58.9′W to 28°03.7′N, 89°58.9′W, *Entophilus omnitectus* 1 ♀, 1 ♂ USNM 240136, host USNM 240135.

Description.—Bourdon (1976) gave excellent descriptions and illustrations of *E. omnitectus* adults. The present material agrees in most details with descriptions of Richardson (1903) and Bourdon (1976) though several differences for the male are noted. The antenna is elongate and more similar to that illustrated by Richardson (1903) than that by Bourdon (1976). All pereopods have five segments. Several males appear to be intermediate between adult and cryptoniscium larva with the pleopodal endopod being a distinct article. Several specimens have a vestigial pleopodal exopod but pereopods are as in mature males. Discussed in greater detail under maturation of the male.

Cryptoniscium larva (Fig. 2): Eyes present. Antennule, biramous; peduncle of 2 articles, distally with a tuft of long setae; basal segment without posterior teeth. Antenna of 9 articles, reaching pereomere 4. Oral cone without terminal sucker. Dorsal cuticular striation not seen, presumed absent. Coxal plates without teeth on posterior and ventral margins; posterior margin weakly scalloped; ventral margin with minute serration; posteroventral corner blunt on pereomere 1, corner becoming elongate on posterior pereomeres. Pereopods increasing in length posteriorly, dactylus with 1 short seta; propodus palm with 2–3 stout spines; carpus distally with 2 long setae and 0–2 stout spines; merus with 1 large spine on posterior margin; ischium and basis grooved to receive distal segments. Pleopods biramous, pleopods 1–3 with 2 setae on distomedial corner of peduncle; exopod quadrate with 1 seta on distolateral corner and 5 long feathered setae; endopod broad, rounded laterally, distally with 5 long feathered setae and distolateral corner with 4 crenations. Pleopod 4 with 2 setae on distomedial corner of peduncle; exopod quadrate with 1 seta on distolateral corner and 4 long feathered setae; endopod quadrate with 4 long feathered setae and distolateral corner with 3 crenations. Pleopod 5, peduncle without setae on distomedial corner; exopod with 1 seta and 4 long feathered setae on distolateral corner; endopod elongate, distally with 4 long feathered setae. Uropod peduncle long, approximately twice length of endopod, distomedial margin with dense band of setae, distomedial corner with 2 strong teeth, distolateral corner with 1 seta; exopod approximately ⅔ length of endopod; endopod with 1 seta on ventral surface. Posterior margin of pleomere 6 entire.

Maturation of the male.—The cryptoniscium larva is larger than the mature male. The larva appears to attain adult form over

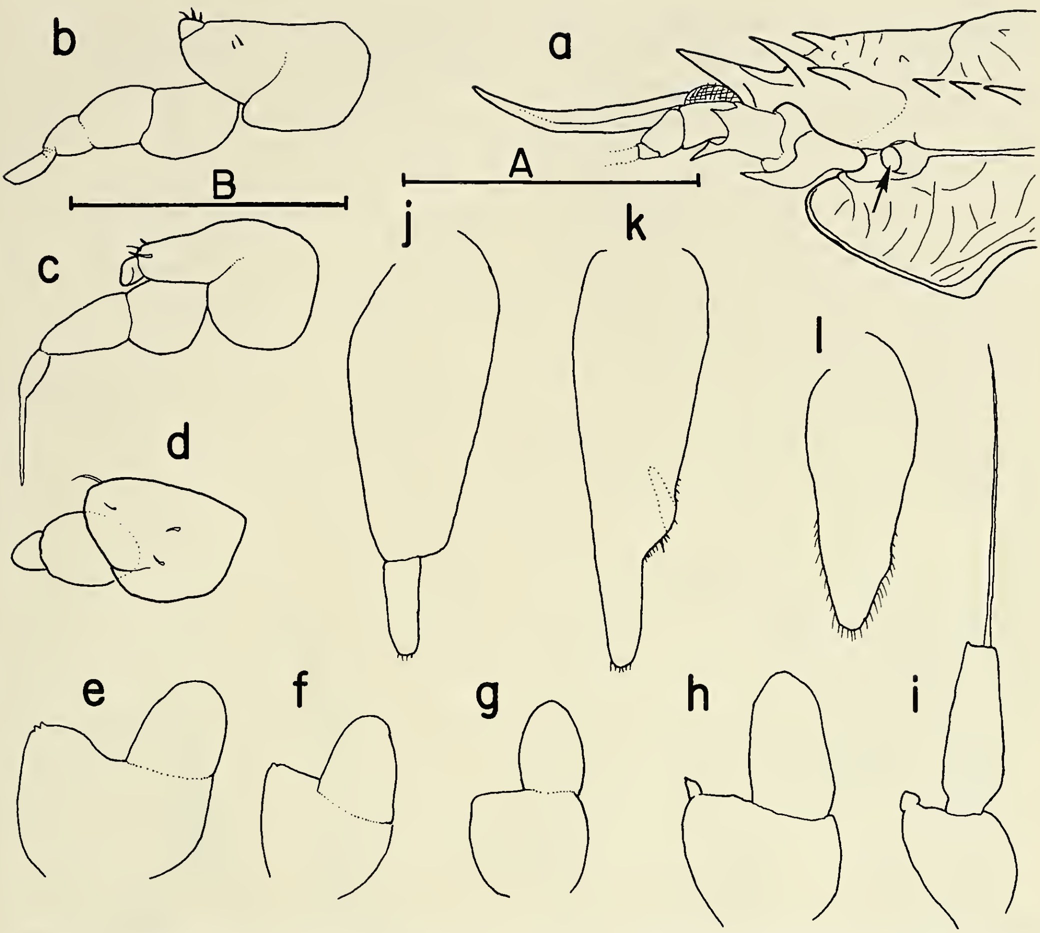

Fig. 1. Host carapace and male of *Entophilus omnitectus*: a, Carapace of *Munida microphthalma* showing exit pore (arrow) of the female *Entophilus omnitectus*, anterolateral view; b–d, Antennae; e, Pleopod 1; f, Pleopod 4; g, Pleopod 5; g, Pleopod 5; h, Pleopod 4; i, Pleopod 5; j–l, Uropod. Scale bar A is 1 cm, for Fig. a; scale bar B is 0.3 mm, for Fig. b to l. Figures from USNM 240136 (host *Munida microphthalma*) a, b, h, i, k. Figures from USNM 240137 c, j. Figures from USNM 240134 d–g, l.

several molts. While pereopods of all male specimens except cryptoniscium larva are of adult form, antennae show variable segmentation. In general, the basal segment of antennule becomes bilobed and then loses its distal articles. Antenna becomes reduced and then loses its flagellar articles, resulting in an appendage of one or two articles. In the adult form, antenna is largely covered by antennule, thus appearing to be the distal articles of antennule.

After the cryptoniscium stage, pleopod setae are lost early except for one long seta on endopod of pleopod 5. This seta reaches nearly to the distal end of the uropod peduncle. Between the cryptoniscium and mature male, two forms of pleopods were found. The first has a free endopod and a vestigial exopod. The later form has a uniramous pleopod with fused endopod. Changes in uropods are similar to those of pleopods. Distal spines, setae and exopod are lost first, followed by the loss of the dense setal band on the peduncle. In one

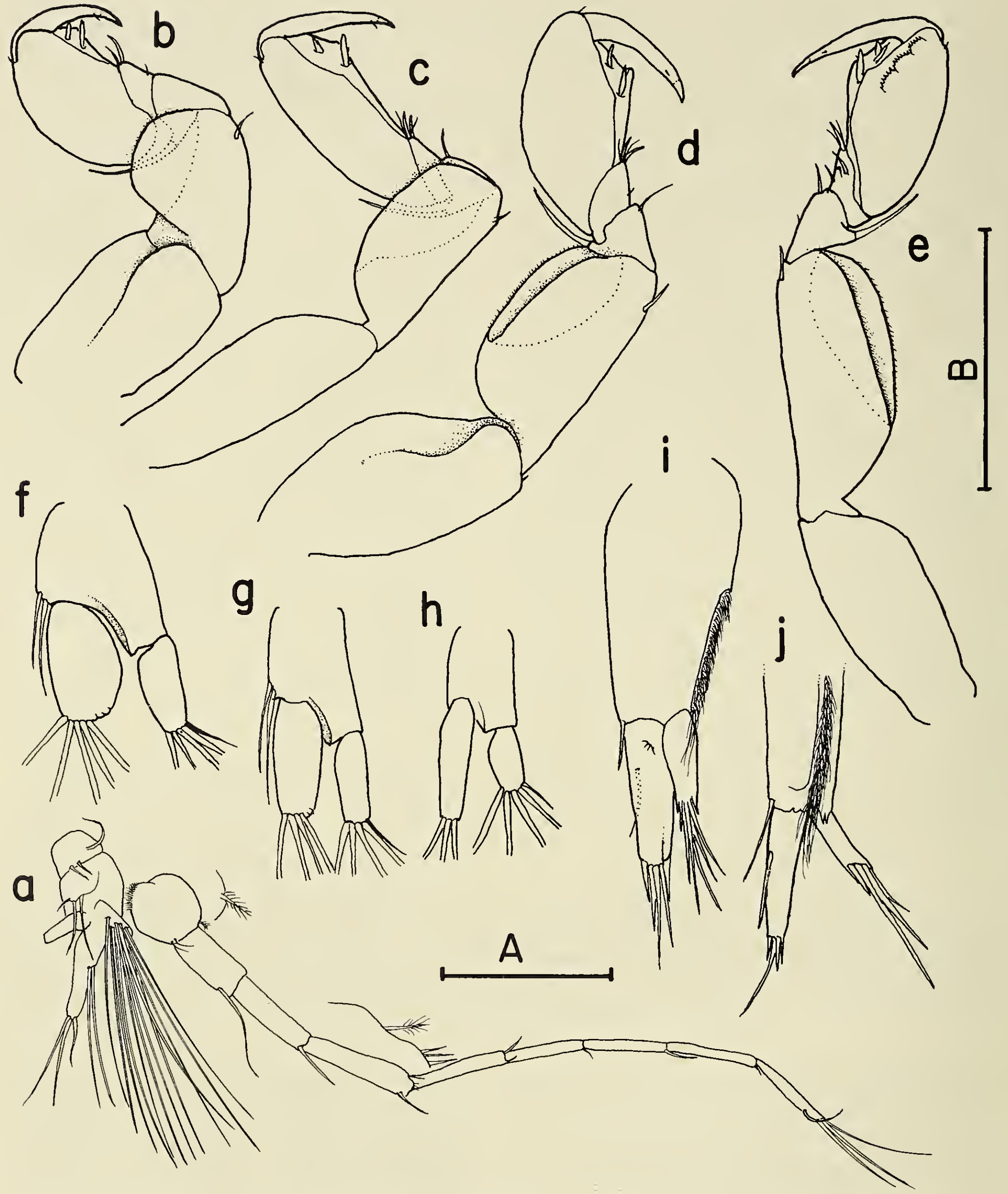

Fig. 2. Cryptoniscium larva: a, Antennae; b, Pereopod 1; c, Pereopod 3; d, Pereopod 5; e, Pereopod 7; f, Pleopod 1; g, Pleopod 4; h, Pleopod 5; i, Uropod, dorsal view; j, Uropod, distal ventrolateral view. Scale bars are 0.3 mm; scale A for Fig. a; scale B for Fig. b to j.

specimen (from *Munida microphthalma*) a deep invagination is present at the location of the dense setal band. Next, the endopod fuses with the peduncle although its location is indicated by the asymmetrical shape of the distal end of the uropod. Last, all indication of the endopod is lost, and the distal end of the uropod is symmetrical.

Distribution.—*Entophilus omnitectus* has a sporadic distribution from off the Hawaiian Islands on *Munida normani* Henderson (type locality; Richardson 1903), off Australia and the Philippines (Bourdon 1976 as unpublished records), off Madagascar Island on *M. incerta* Henderson (Bourdon 1976), off the Azores on *M. sanctipauli* Henderson (Bourdon 1979) and in the Gulf of Mexico on *M. microphthalma* and *M. valida* (reported here).

Position of parasite.—Danforth (1963, 1970) described the position of female *Entophilus omnitectus* as mid-dorsal under the host's carapace. In the present material and those reported by Bourdon (1976), the female *E. omnitectus* is located anterolaterally under the host's carapace, anterior to branchial chamber. The female parasite is oriented with the posterior end of its pleon at the larval exit pore. The long axis of the female is directed obliquely across the host towards the lateral wall on the other side of the host's carapace. The dorsal surface of female parasite is directed toward the ventral surface of host and the brood chamber faces the dorsal surface of the host's carapace. As in Bopyridae and Dajidae, the male is usually found on ventral surface of the female pleon. As previously noted, presence of an adult female parasite is indicated by a swelling on the dorsal surface of the host's carapace and a small pore anterior to branchiostegite region of the carapace.

Female *Entophilus omnitectus* are enclosed in a host-derived sheath that appears similar to but thicker than the sheath surrounding female entoniscid isopods. The host derived-sheath around *E. omnitectus* is in less intimate contact with the female parasite than around female entoniscids (Shiino 1942, Kuris et al. 1980) where the sheath is very difficult to remove without damaging the specimen. Like the entoniscids (Kuris et al. 1980), *Entophilus omnitectus* is clearly an internal parasite.

Discussion.—For the nine hosts with an adult female *E. omnitectus*, female parasite length is 39% (range 33 to 45%) of host carapace length. The length of the two immature female parasites are 19% of host carapace length. In both cases, the host with an immature female had a partly closed larval exit pore and no dorsal swelling of the host carapace. The remains of the previous adult female *E. omnitectus* were found at the larval exit pore in specimen, FSBC I-33082, and the immature female parasite was found in a swelling on the lateral margin of the host carapace dorsal to the larval exit pore. In the other case (USNM 240131), the immature parasite was found in a "normal" position, with its pleon at the partly closed larval exit pore. It is unknown whether the immature females (both without males) were the transformed males of the previous adult female or the result of subsequent infestation.

Entophilus omnitectus has low numbers of large eggs per clutch. The number of eggs in three broods are 435 (USNM 240134), 563 (USNM 240124), and 1524 (FSBC-I33079). One female carried 2228 embryos (USNM 240126). The average egg diameters for four broods were 403 μm (USNM 240124), 438 μm (FSBC-I33079), 548 μm (USNM 240131), and 561 μm (USNM 240134). The number of eggs and clutch volume (calculated by treating eggs as spheres and multiplying egg volume times number of eggs) were not found to be related to length of either female parasite or host. Eggs of *Entophilus omnitectus* are the largest reported for any epicaridean and are within the size range of eggs of other isopods (Stromberg 1971).

Of the 11 hosts infested by *Entophilus omnitectus*, only four were not parasitized by females of other parasites. Six hosts were infested by *Aporobopyrina anomala*, three were infested by an unidentified rhizocephalan, and two were infested by females of all three parasites. One rhizocephalan appears parasitized by a cryptoniscid isopod. Markham (1973) reported the simultaneous infestation of *Munida valida* by a rhizocephalan and *A. anomala*.

The known distribution of *Entophilus omnitectus* is sporadic, no doubt in part due to the relatively subtle inflation of the host carapace when compared to that caused by the branchial bopyrids. The examination of galatheoids using the signs of infestation noted above will turn up more material and should help address the question of whether *E. omnitectus* is a single species or a species complex.

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